DESIGN AND FABRICATE ROCKET ENGINE

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Report submitted in partial fulfilment of the requirements
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JUDUL: DESIGN AND FABRICATION OF A ROCKET ENGINE

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I hereby declare that I have checked this project report and in my opinion this project is satisfactory in terms of scope and quality for the award of Diploma in Mechanical Engineering.

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Position:DEPUTY DEAN

Date:25 NOVEMBER 2010

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I hereby declare that the work in this report is my own except for quotations and summaries which have been duly acknowledged. The report has not been accepted for any degree and is not concurently submitted for award of other degree.

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ABSTRACT

The objective of this project is to design and fabricate the Rocket Engine.This project describe the shape of Rocket that will fabricate follow the dimension that give by my supervisor.Actually there a several type of Rocket Engine.There are Rocket Engine based of thermal,water,hybrid,solid,and resistojet(electronic).So,the Rocket that will fabricate is from the solid type.One of the important thing a rocket is type of noozle,from the research in the internet De'Laval Noozle is the better type of noozle to use.Then material also another important thing in making Rocket.Material that will use must have good enough strenght to hold the explosion that will happen to move up the rocket.The better material is Stainless Steel it is light and have a good strenght,but cause of limited soucrce the material that use for make this Rocket is from mild steel.It is also have good strenght but it heavy than stainless steel.This project start from making the design and make it using Solid Work Software.Finish the design then the rocket can be made use a Lathe Machnine.Majority this rocket will be made by Lathe Machine.But from the start of fabricte the machine that involve also like bendsaw and drilling machine.Rocket engine that will be made have three part.First part is cap to close the hole on the upper body,a body and noozle.All this part will be assembly and were tied by bolt.It was susessfully done and able to function as needed.

ABSTRAK

Tujuan dari projek ini adalah untuk merancang dan membuat projek Rocket Engine. This projek menggambarkan bentuk Rocket yang akan dibuat mengikut ukuran yang diberikan oleh penyelia.Sebenarya ada pelbagai jenis Rocket Engine.Antaranya adalah Rocket Engine berasaskan therma,air, hibrid, motor, dan resistojet (elektronik). Jadi, roket yang akan dibuat adalah dari jenis solid atau motor.Salah satu perkara yang penting tentang membuat roket adalah jenis nozzle, daripada kajian di internet De'Laval Noozle adalah jenis yang lebih baik untuk digunakan.Selain itu bahan yg digunakan untuk membuat roket juga adlah penting.Bahan roket yang akan digunakan harus mempunyai kekuatan yang cukup baik untuk menahan ledakan yang akan terjadi untuk bergerak ke atas bahan rocket. Stainless Steel itu adalah ringan dan mempunyai kekuatan yang baik, tapi disebabkan sumber bahan yang terhad bahan yang digunakan untuk membuat roket ini adalah dari jenis mild steel.Ia ringan juga mempunyai kekuatan yang baik tetapi berat daripada stainless steel.Reka bentuk projeknya ini akan di lukis menggunakan Solid Work Software.Tamat sahaja mereka bentuk maka roket boleh dibuat menggunakan mesin larik.Keseluruhanya roket ini akan dibuat menggunakan mesin larik. Pembuatan roket tidak hanya bergantung dari mesin larik.Tetapi dari awal fabrikasi mesin yang melibatkan juga adalah ‘bendsaw’ dan fungsi gerudi mesin juga tidak ketinggalan turut digunakan.Rocket yang akan dibuat mempunyai tiga bahagian.Pertama adalah bahagian cap untuk menutup lubang pada tubuh bahagian atas, badan dan noozle.Semua bahagian ini akan diikat dengan bolt. Projek ini selesai dilakukan dan mampu berfungsi sebagai diperlukan.

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Ve	Veloxity Exit	(m/s^2)
Ae	Area Exit	(m)
Pe	Pressure Exit	(pa)
M	Moment	(Nm)

CHAPTER 1

INTRODUCTION

1.1 PROJECT SYNOPSIS

The project including the design and fabricate of Rocket Design. The rocket that will fabricate is just a prototype it is not same as rocket that already have. In producing the design of rocket engine, there are including with the process of generating concept, design the concept and fabrication.The rocket engine that will build in two type first for the launching in the air and second for the testing.Both rocket will made from mild steel cause of limited source.Before this in the planning the rocket will build from stainless steel,it is because stainless steel more light and also have a good strength to hold exploded combustion that will happen in the rocket.But mild steel also have a good strength and a little bit heavy from the stainless steel.In the fabrication process rocket will be divided with three part.First part is cap then body and follow by the nozzle at the bottom.To making this part all of it will done by using lathe machine.Then for the assembly drilling process is needed to make a hole at the all of the part and follow by threading to make it easily to enter by bolt.For the test rocket it need trolley to make a testing .The trolley will fabricate using bending machine.It body from plate cause it more hard and can hold the high temperature of fire that out from noozle.

1.1 PROBLEMS STATEMENT

The problem statement is to find the suitable material as a Rocket engine body.The material have a good strength and light so the rocket can operate kindly.

1.2 PROJECT'S OBJECTIVE.

The objective for this project is: To design and fabricate a rocket engine

1.3 PROJECT'S SCOPE.

Two rocket engine will be design and fabricate every rocket have different function.First rocket for the launcher in the air and second for the testing.The rocket that will build is from the type of solid rocket.

1.4 THE PROJECT PLANNING.

Following to the Gantt chart, the project started with getting the problem statement, scope and the objective for the project. This process include with the getting the project title, first meeting with the supervisor, getting the information that regarding to this project through internet and the other sources for literature review. This planning is from week 1 until week 4.

Then, the designing stage start at studying the Morphological chart, verify the product design a concept of rocket. At this stage, the concepts is sketched and designed by using the SolidWorks software. This planning is running in week 3 to week 6.

For the week 5 until week 8, the materials selection is done and the fabrication process is started. All the materials are shaped and join together by using welding and fastening process, and the measurements are verified before running the cutting process.

The pre-presentation and first draft submission is done on week 7.After semester break, the fabrication process on the project including with the finishing process are continue until the week 13, project report that start from week 3 is continued until week 13 and lastly the final presentation on week 14.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Literature Review of this project is totally highlated the research about rocket engine.All information will be explain in this chapter.

2.2 ROCKET ENGINE

2.2.1 Rocket Engine Synopsis

A **rocket engine**, or simply "rocket," is a jet engine that uses only propellant mass for forming its high speed propulsive jet. Rocket engines are reaction engines and obtain thrust in accordance with Newton's third laws. Since they need no external material to form their jet, rocket engines can be used for spacecraft propulsion as well as terrestrial uses, such as missiles. Most rocket engines are internal combustion engines, although non combusting forms also exist.Rocket engines as a group, have the highest exhaust velocities, are by far the lightest, and are the most energy efficient (at least at very high speed) of all types of jet engines. However, for the thrust they give, due to the high exhaust velocity and relatively low specific energy of rocket propellant, they consume propellant very rapidly.The important thing went making a rocket is a shape and dimension of nozzle.The large bell or cone shaped expansion nozzle gives a rocket engine its characteristic shape.In rockets the hot gas produced in the combustion chamber is permitted to escape from the combustion chamber through an opening (the "throat"), within a high expansion-ratio 'de Laval nozzle'.Provided sufficient pressure is provided to the nozzle *chokes* and a supersonic jet is formed, dramatically accelerating the gas, converting most of the thermal energy into kinetic energy.The exhaust speeds vary, depending on the expansion ratio

The nozzle is designed to give, but exhaust speeds as high as ten times the speed of sound of sea level air are not uncommon.Rocket thrust is caused by pressures acting in the combustion chamber and nozzle. From Newtons third law, equal and opposite pressures act on the exhaust, and this accelerates it to high speeds.About half of the rocket engine's thrust comes from the unbalanced pressures inside the combustion chamber and the rest comes from the pressures acting against the inside of the nozzle (see diagram). As the gas expands (adiabatically) the pressure against the nozzle's walls forces the rocket engine in one direction while accelerating the gas in the other.

2.2.2 Type Of Rocket Engine

There are several different type of rocket. There are solid rocket, liquid rocket, hybrid rocket and thermal rocket. Every type of this rocket have their different operational than others rocket.

i) Hybrid Rocket

A **hybrid rocket** is a rocket with a rocket engine which uses propellants in two different states of matter - one solid and the other either gas or liquid. The Hybrid rocket concept can be traced back at least 75 years. Hybrid rockets exhibit advantages over both liquid rockets and solid rockets especially in terms of simplicity, safety, and cost.[2] Because it is nearly impossible for the fuel and oxidizer to be mixed intimately (being different states of matter), hybrid rockets tend to fail more benignly than liquids or solids. Like liquid rockets and unlike solid rockets they can be shut down easily and are simply throttle-able. The theoretical specific impulse(I_{sp}) performance of hybrids is generally higher than solids and roughly equivalent to hydrocarbon-based liquids. I_{sp} as high as 400s has been measured in a hybrid rocket using metalized fuels.[3] Hybrid systems are slightly more complex than solids, but the significant hazards of manufacturing, shipping and handling solids offset the system simplicity advantages.

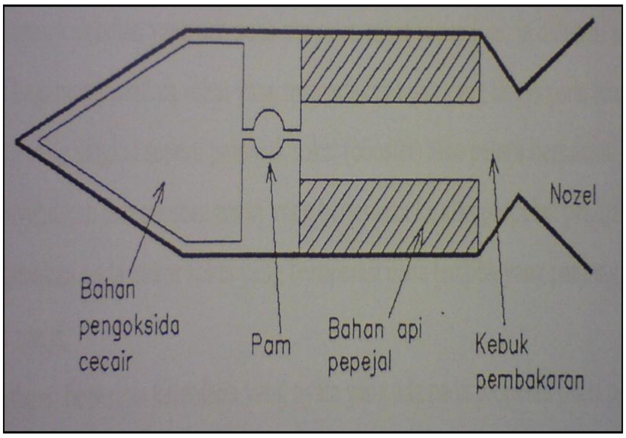

Figure 2.1:Hybrid Rocket

SOURCE**:**Ciri-Ciri Propelan Roket Pepejal Berasaskan Kalium By Rizalman Mamat

ii) Thermal rocket

a) Nuclear Thermal Rocket

In a nuclear thermal rocket a working fluid, usually liquid hydrogen, is heated to a high temperature in a nuclear reactor, and then expands through a rocket nozzle to create thrust. The nuclear reactor's energy replaces the chemical energy of the reactive chemicals in a chemical rocket engine. Due to the higher energy density of the nuclear fuel compared to chemical fuels, about 10^7 times, the resulting propellant efficiency (effective exhaust velocity) of the engine is at least twice as good as chemical engines. The overall gross lift-off mass of a nuclear rocket is about half that of a chemical rocket, and hence when used as an upper stage it roughly doubles or triples the payload carried to orbit.

A nuclear engine was considered for some time as a replacement for the J-2 used on the S-II and S-IVB stages on the Saturn V and Saturn I rockets. Originally "drop-in" replacements were considered for higher performance, but a larger replacement for the S-IVB stage was later studied for missions to Mars and other high-load profiles, known as the S-N. Nuclear thermal space "tugs" were planned as part of the Space Transportation System to take payloads from a propellant depot in Low Earth Orbit to higher orbits, the Moon, and other planets. Robert Bussard proposed the Single-Stage-To-Orbit "Aspen" vehicle using a nuclear thermal rocket for propulsion and liquid hydrogen propellant for partial shielding against neutron back scattering in the lower atmosphere. The Soviets studied nuclear engines for their own moon rockets, notably upper stages of the N-1, although they never entered an extensive testing program like the one the U.S. conducted throughout the 1960s at the Nevada Test Site. Despite many successful firings, American nuclear rockets did not fly before the space race ended.

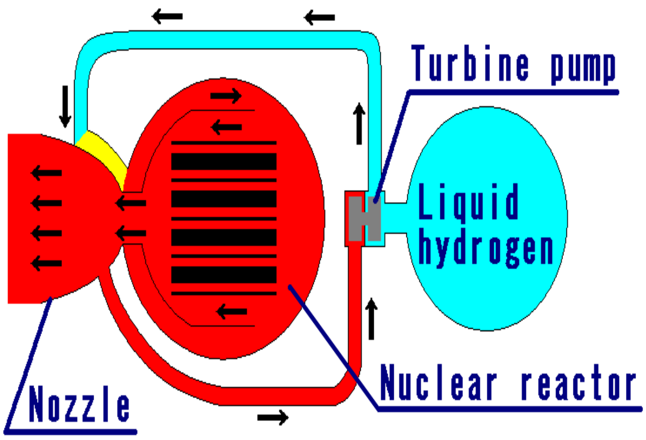

Figure 2.2:Nuclear Thermal Rocket

Source**:**Wikimedia.org

b) Solar Thermal Rocket

Solar thermal propulsion is a form of spacecraft propulsion that makes use of solar power to directly heat reaction mass, and therefore does not require an electrical generator as most other forms of solar-powered propulsion do. A solar thermal rocket only has to carry the means of capturing solar energy, such as concentrators and mirrors. The heated propellant is fed through a conventional rocket nozzle to produce thrust. The engine thrust is directly related to the surface area of the solar collector and to the local intensity of the solar radiation.

In the shorter term, solar thermal propulsion has been proposed as a good candidate for use in reusable inter-orbital tugs, as it is a high-efficiency low-thrust system that can be refuelled with relative ease.

There are two basic solar thermal propulsion concepts, differing primarily in the method by which they use solar power to heat the propellant.

- Indirect solar heating involves pumping the propellant through passages in a heat exchanger that is heated by solar radiation. The windowless heat exchanger cavity concept is a design taking this radiation absorption approach.
- Direct solar heating involves exposing the propellant directly to solar radiation. The rotating bed concept is one of the preferred concepts for direct solar radiation absorption; it offers higher specific impulse than other direct heating designs by using a retained seed (tantalum carbide or hafnium carbide) approach. The propellant flows through the porous walls of a rotating cylinder, picking up heat from the seeds, which are retained on the walls by the rotation. The carbides are stable at high temperatures and have excellent heat transfer properties.

iii) Liquid Rocket

A liquid-propellant rocket or a liquid rocket is a rocket with an engine that uses propellants in liquid form. Liquids are desirable because their reasonably high density allows the volume of the propellant tanks to be relatively low, and it is possible to use lightweight pumps to pump the propellant from the tanks into the engines, which means that the propellants can be kept under low pressure. This permits the use of low mass propellant tanks, permitting a high mass ratio for the rocket.Liquid rockets have been built as monopropellant rockets using a single type of propellant, bipropellant rockets using two types of propellant, or more exotic tripropellant rockets using three types of propellant. Bipropellant liquid rockets generally use one liquid fuel and one liquid oxidizer, such as liquid hydrogen or a hydrocarbon fuel such as RP-1, and liquid oxygen. This example also shows that liquid-propellant rockets sometimes use cryogenic rocket engines, where fuel or oxidizer are gases liquefied at very low temperatures.Liquid propellants are also sometimes used in hybrid rockets, in which they are combined with a solid or gaseous propellant.

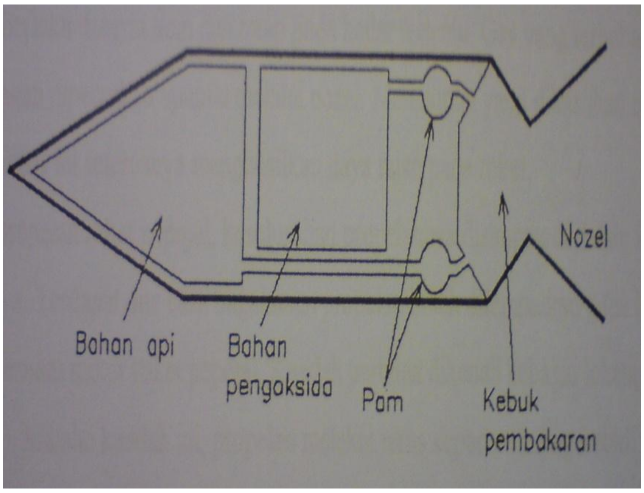

Figure 2.3: Liquid Rocket

SOURCE: Ciri-Ciri Propelan Roket Pepejal Berasaskan Kalium By Rizalman Mamat

iv) Solid Rocket

A **solid rocket** or a **solid-fuel rocket** is a rocket with a motor that uses solid propellants (fuel/oxidizer). The earliest rockets were solid-fuel rockets powered by gunpowder; they were used by the Indians, Chinese, Mongols and Arabs, in warfare as early as the 13th century.

All rockets used some form of solid or powdered propellant up until the 20th century, when liquid rockets and hybrid rockets offered more efficient and controllable alternatives. Solid rockets are still used today in model rockets and on larger applications for their simplicity and reliability.

Since solid-fuel rockets can remain in storage for long periods, and then reliably launch on short notice, they have been frequently used in military applications such as missiles. Solid-fuel rockets are unusual as primary propulsion in modern space exploration, but are commonly used as booster rockets.

A simple solid rocket motor consists of a casing, nozzle, grain (propellant charge), and igniter.

The grain behaves like a solid mass, burning in a predictable fashion and producing exhaust gases. The nozzle dimensions are calculated to maintain a design chamber pressure, while producing thrust from the exhaust gases.

Once ignited, a simple solid rocket motor cannot be shut off, because it contains all the ingredients necessary for combustion within the chamber in which they are burned. More advanced solid rocket motors can not only be throttled but also be extinguished and then re-ignited by controlling the nozzle geometry or through the use of vent ports. Also, pulsed rocket motors that burn in segments and that can be ignited upon command are available.

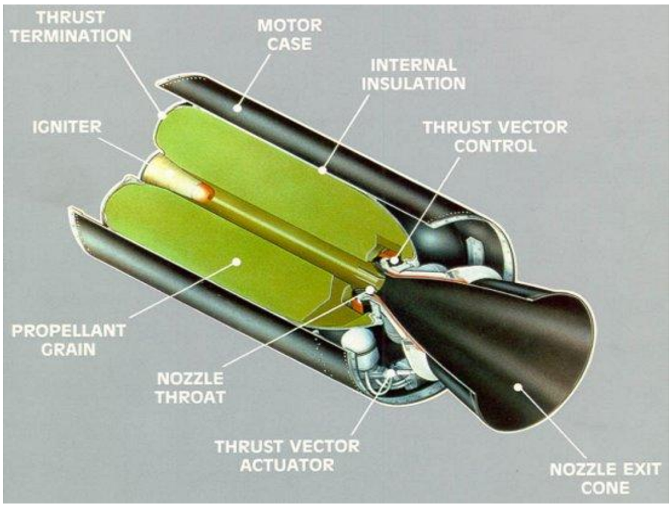

Figure 2.4: Solid Rocket

Source:purdue.edu

2.3 WHAT IS SOLID ROCKET?

Solid rocket engine or motor rocket engine is the type of rocket that use on air to air and air to ground missiles on rocket besides that it also use as a booster for satellite launchers. In a solid rocket, the fuel and oxidizer are mixed together into a solid propellant which is packed into a solid cylinder. A hole through the cylinder serves as a combustion chamber. When the mixture is ignited, combustion takes place on the surface of the propellant. A flame front is generated which burns into the mixture. The combustion produces great amounts of exhaust gas at high temperature and pressure. The amount of exhaust gas that is produced depends on the area of the flame front and engine designers use a variety of hole shapes to control the change in thrust for a particular engine. The hot exhaust gas is passed through a nozzle which accelerates the flow. Thrust is then produced according to Newton's third law of motion.

The amount of thrust produced by the rocket depends on the design of the nozzle. The smallest cross-sectional area of the nozzle is called the throat of the nozzle. The hot exhaust flow is choked at the throat, which means that the Mach number is equal to 1.0 in the throat and the mass flow rate **m dot** is determined by the throat area. The area ratio from the throat to the exit **Ae** sets the exit velocity **Ve** and the exit pressure **pe**. You can explore the design and operation of a rocket nozzle with our interactive nozzle simulator program which runs on your browser.

The exit pressure is only equal to free stream pressure at some design condition. We must, therefore, use the longer version of the generalized thrust equation to describe the thrust of the system. If the free stream pressure is given by **p0**, the thrust **F** equation becomes:

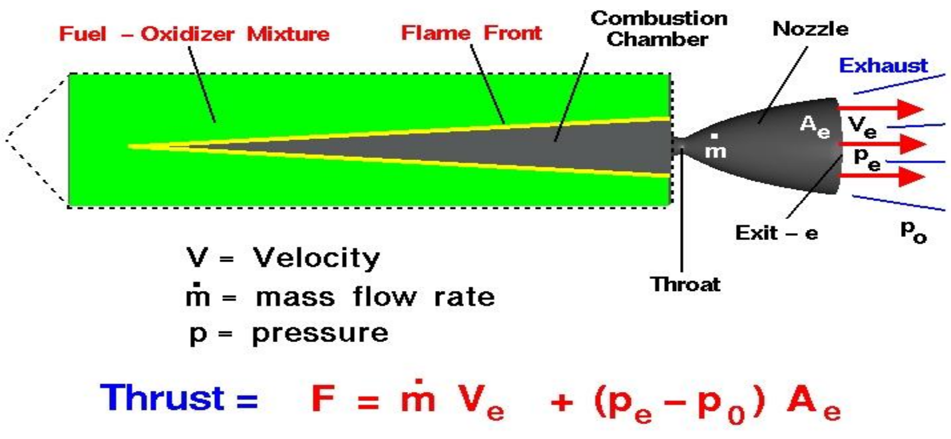

Figure 2.5: Rocket Thrust

Source:nasa.gov

There is no free stream mass times free stream velocity term in the thrust equation because no external air is brought on board. Since the oxidizer is mixed into the propellant, solid rockets can generate thrust in a vacuum where there is no other source of oxygen. That's why a rocket will work in space, where there is no surrounding air, and a gas turbine or propeller will not work. Turbine engines and propellers rely on the atmosphere to provide the oxygen for combustion and as the working fluid in the generation of thrust.

The thrust equation given above works for both liquid and solid rocket engines. There is also an efficiency parameter called the specific impulse which works for both types of rockets and greatly simplifies the performance analysis for rocket engines.

2.4 ADVANTAGE OF SOLID ROCKET

To the user advantage of solid rocket in missiles are the avoidance of field servicing equipment,the staright foward handling and easy firing ,usually with simple electrical circuits These features constant clearly with the employment in the early days of liquid propellant engines particularly those using cryogenic propellants,as well be seen in the later sections on liquid propellants.More up-to-date packaged liquid propellants rockets are much more straitght foward and almost on a part with solid propellants motors.However don not currently have wide application**.**

2.5 PROPELLANT

Propellant is the one of main important thing in making rocket successfully operate.It is mass that that stored on some form of propellant tank and then were injected from a rocket engine.In other explanation it is the fuels and oxidexer carried by the rocket propulsion.There are variety of difererent fuels and oxidexer because they all have tradeoff.A little overview about propellant, rockets create thrust by expelling mass backwards in a high speed jet .Then the propellant create thrust by reacting propellants within a combustion chamber into a very hot gas at high pressure, which is then expanded and accelerated by passage through a nozzle at the rear of the rocket. The amount of the resulting forward force, known as thrust, that is produced is the mass flow rate of the propellants multiplied by their exhaust velocity (relative to the rocket), as specified by Newton's third law of motion. Thrust is therefore the equal and opposite reaction that moves the rocket, and not by interaction of the exhaust stream with air around the rocket.There are three main type of propellant.Differnt type of rocket use different type of propellant.The first one is solid then liquid and follow by hybrid.

PROPERTIES OF ROCKET PROPELLANTS					
Compound	Chemical Formula	Molecular Weight	Density	Melting Point	Boiling Point
Liquid Oxygen	O_2	32.00	1.14 g/ml	-218.8°C	-183.0°C
Liquid Fluorine	F_2	38.00	1.50 g/ml	-219.6°C	-188.1°C
Nitrogen Tetroxide	N_2O_4	92.01	1.45 g/ml	-9.3°C	21.15°C
Nitric Acid	HNO_3	63.01	1.55 g/ml	-41.6°C	83°C
Hydrogen Peroxide	H_2O_2	34.02	1.44 g/ml	-0.4°C	150.2°C
Nitrous Oxide	N_2O	44.01	1.22 g/ml	-90.8°C	-88.5°C
Chlorine Pentafluoride	ClF_5	130.45	1.9 g/ml	-103°C	-13.1°C
Ammonium Perchlorate	ClH_4NO_4	117.49	1.95 g/ml	240°C	N/A
Liquid Hydrogen	H_2	2.016	0.071 g/ml	-259.3°C	-252.9°C
Liquid Methane	CH_4	16.04	0.423 g/ml	-182.5°C	-161.6°C
Ethyl Alcohol	C_2H_5OH	46.07	0.789 g/ml	-114.1°C	78.2°C
n-Dodecane (Kerosene)	$C_{12}H_{26}$	170.34	0.749 g/ml	-9.6°C	216.3°C
RP-1	$C_nH_{1.953n}$	≈175	0.820 g/ml	N/A	177-274°C
Hydrazine	N_2H_4	32.05	1.004 g/ml	1.4°C	113.5°C
Methyl Hydrazine	CH_3NHNH_2	46.07	0.866 g/ml	-52.4°C	87.5°C
Dimethyl Hydrazine	$(CH_3)_2NNH_2$	60.10	0.791 g/ml	-58°C	63.9°C
Aluminum	Al	26.98	2.70 g/ml	660.4°C	2467°C
Polybutadiene	$(C_4H_6)_n$	≈3000	≈0.9 g/ml	N/A	N/A

Table 2.1: Properties of Rocket Propellants

Source:brauenig.us

2.6 De LAVAL NOZZLE

A de Laval nozzle (or convergent-divergent nozzle, CD nozzle or con-di nozzle) is a tube that is pinched in the middle, making a carefully balanced, asymmetric hourglass-shape. It is used to accelerate a hot, pressurised gas passing through it to a supersonic speed, and upon expansion, to shape the exhaust flow so that the heat energy propelling the flow is maximally converted into directed kinetic energy. Because of this, the nozzle is widely used in some types of steam turbine, it is an essential part of the modern rocket engine, and it also sees use in supersonic jet engines.

The laval noozle was frist develop by Swedish inventor Gustaf de Laval.That's why this noozle were called de laval.This principle was first used in a rocket engine by Robert Goddard.Nowadays all modern rocket engines that employ hot gas combustion use this noozle.

Operation of this noozle relies on the different porperites of gases flowing at subsonic and supersonic speeds.The speed of a sunsonic flow gas will increase if the pipe carrying it narrows because the mass flow rate is constant. At subsonic flow the gas is compressible, sound, a small pressure wave, will propagate through it. At the "throat", where the cross sectional area is a minimum, the gas velocity locally becomes sonic, a condition called choked flow. As the nozzle cross sectional area increases the gas begins to expand and the gas flow increases to supersonic velocities where a sound wave will not propagate backwards through the gas as viewed in the frame of reference of the nozzle .

A de Laval nozzle will only choke at the throat if the pressure and mass flow through the nozzle is sufficient to reach sonic speeds, otherwise no supersonic flow is achieved and it will act as a Venturi tube.In addition, the pressure of the gas at the exit of the expansion portion of the exhaust of a nozzle must not be too low. Because pressure cannot travel upstream through the supersonic flow, the exit pressure can be significantly below ambient pressure it exhausts into, but if it is too far below ambient, then the flow will cease to be supersonic, or the flow will separate within the expansion portion of the nozzle, forming an unstable jet that may 'flop' around within the nozzle, possibly damaging it.

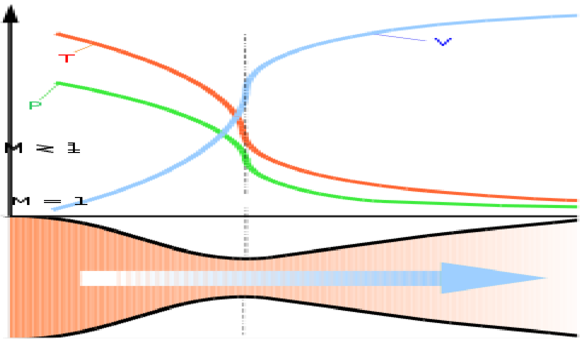

Figure 2.6: De Laval Noozle Shape

Source:Wikimedia.org

2.7 REVIEW ON THE SELECTED MATERIAL

2.7.1 Stainless steel's

Stainless Steel resistance to corrosion and staining, low maintenance, relatively low cost, and familiar luster make it an ideal base material for a host of commercial applications. There are over 150 grades of stainless steel, of which fifteen are most common. The alloy is milled into coils, sheets, plates, bars, wire, and tubing to be used in cookware, cutlery, hardware, surgical instruments, major appliances, industrial equipment, and as an automotive and aerospace structural alloy and construction material in large buildings. Storage tanks and tankers used to transport orange juice and other food are often made of stainless steel, due to its corrosion resistance and antibacterial properties. This also influences its use in commercial kitchens and food processing plants, as it can be steam cleaned, sterilized, and does not need painting or application of other surface finishes.

2.7.2 Mild Steel

Mild Steel also called carbon steel like as a stainless steel,it have a good strength to hold the exploded of propellant to make a combustion in rocket.But it is not resistance to corrosion and it also heavy than stainless steel.Besides that it is cheap than stainless steel ,wide variable available with different properties. Typically carbon steels are stiff and strong. They also exhibit ferromagnetism or magnetic ability.Most carbon steel are easy machine and weld.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Methodology includes a philosophy coherent collection of theories,concepts or ideas as they to a particular discipline or field of inquiry. In this chapter the analysis of the methods appropriate to a field of study or to the body of methods and principles particular to a branch of knowledge will be explain more briefly.All work is done step by step like and all the process step show on the flow chart.

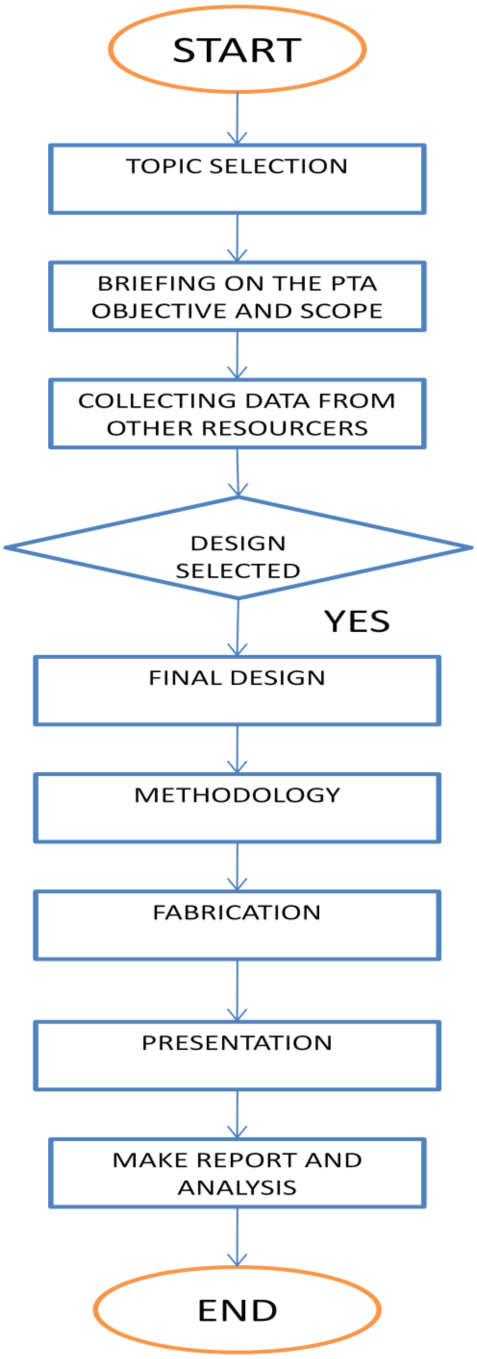

Figure 3.1:Flow Chart

3.2 DESIGN

After get the tittle of the project,the specific design actually have be given by my supervisor.The design have already fix dimension for all part start from cap,body and noozle.The material also have be choose early.But cause of the limited source and time all of that have change and new dimension have be made and material also change to other material that suitable with the project.Making a Rocket Engine the dimension of the rocket have to follow the standard to make sure the rocket is sucsessfull launch.

3.2.1 Test Rocket Design

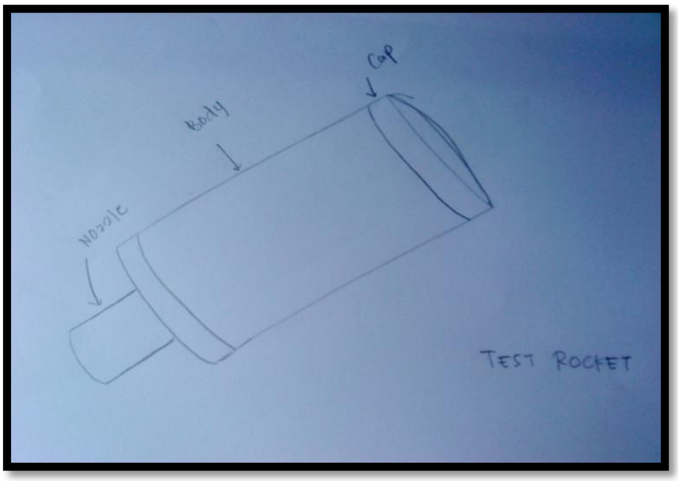

Figure 3.2:Test Rocket Sketch

3.2.2 Launch Rocket Design

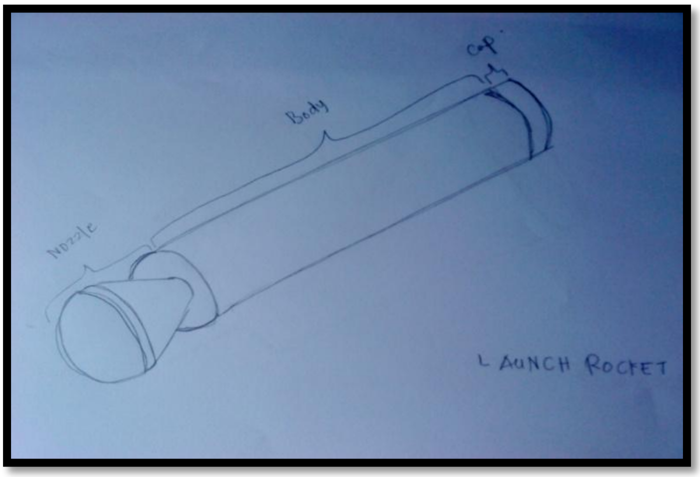

Figure 3.3: Launch Rocket Sketch

The design for the project must consider all the aspects and be done carefully to make the rocket can operate and finish the fabricate on due date. The aspects that must be considered are body structure strength ,the body thickness then size of nozzle and lastly ie ease to fabricate.

3.3 DRAWING

After a sketching the design have be done,then the sketch need to transfer into the drawing software for more detail information.The software is from SolidWork Drawing.It can draw in the three dimension and make drawing easy to understand.

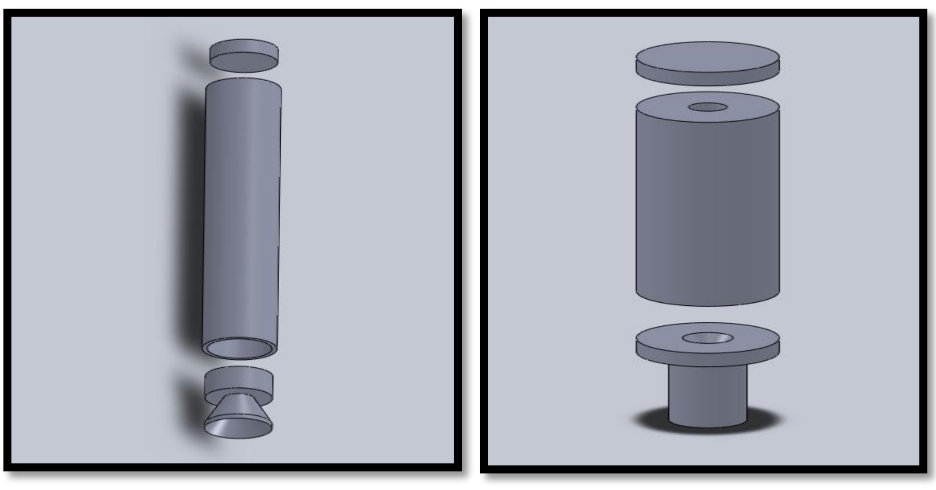

Figure 3.4: Example of launch and test rocket explode view

3. 4 MATERIAL CHOOSING

The choice of materials for a project requires considerations of aesthetic appeal and initial and ongoing costs, life cycle assessment considerations (such as material performance, availability and impact on the environment). Materials must be used sustainably ,this means the present use will not compromise future use by running out or harming the environment at any time.Besides that the choosing of material also need to consider the need of project. Few materials fully meet this criteria. Example the aim when selecting materials for making a rocket the most important it must have a enough strength to hold the exploded combustion that will happen in the combustion chamber.

Before make a fabrication the first one need to do is find the material for fabrication process.All solid or hollow material can get at the central store.The material that have choose as a project material is mild steel solid rode and mild steel hollow rode.

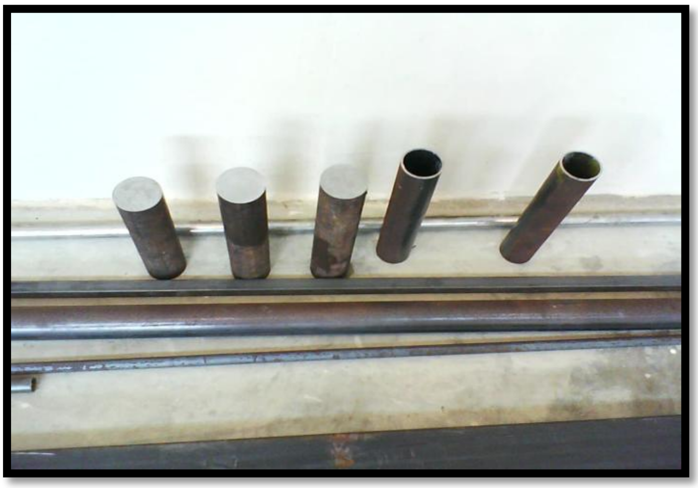

Figure 3.5:Material(mild steel)

3.5 FABRICATION PROCESS

3.5.1 Measuring

In science ,measurement is the process of obtaining the magnitude of a quality such as length or mass relative to unit measurements.such as meter or a kilogram.The term can also be used to refer the result obtained after performing process. First is make a measuring at part that want be fabricate.All part have a different dimension so it need to measure correctly and accurate.It cause,when the dimension not same anymore with the true dimension there have a possibility the rocket will not operate kindly.

Figure 3.6: Measuring material

3.5.2 Marking

After the measuring process were finish ,the place that measure need to mark so we can now where part is need and where is not use.

Figure 3.7: Marking at material

3.5.3 Fabricate(Lathe Machine)

Fabrication as an industrial term refers to building metal structures by cutting, bending, and assembling. The cutting part of fabrication is via sawing, shearing, or chiseling (all with manual and powered variants) and via CNC cutters (using a laser, plasma torch, or water jet).In this project the example use for fabrication is lathe machine and band saw. After measuring and marking process the material is ready to fabricate using a lathe machine. In the UMP FKM lab there is have two type of lathe machine. The new one name Pincaho anda the older one is si Chi Shuan.The Pinacho is better than Chi Shuan because it have more function like can control the speed manually and others update function.

Figure 3.8: Fabricate use Lathe Matchine

FIGURE 3.9: Turning Process

3.5.4 Cutting

Cutting is the separation of a physical object, or a portion of a physical object, into two portions, through the application of an acutely directed force. The phase of cutting process start Next after process fabricate finish .The material will cut and divide it into cap body and noozle.The machine that involve is bend saw.

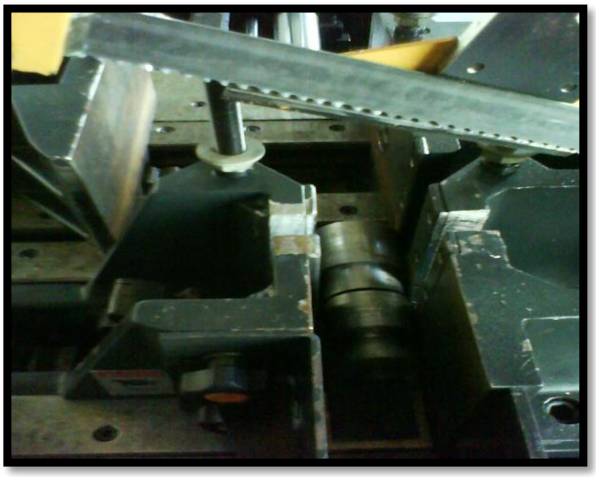

Figure 3.10: Cutting using band saw

3.5.5 Drilling

At the body there is need make a hole so that have a space to put a propellant. Besides that to joining all the part cap, body and nozzle it also need to make a hole around the all part. The number of hole is six. It is for make thread than the screw or bolt can enter easily and joint the part tightly.

Figure 3.11: Drilling Process

3.5.6 Joining

There is many type of method for joining can be done. But for my project the method that us to joint its just use a blot and screw. Joining is the next step after all by use allen head bolt and screw the process is finish. The allen key and screwdriver will be use to help the bolt and screw enter into the hold easily and smooth.

Figure 3.12: Launch Rocket and Test Rocket after joining

Figure 3.13: Troley for the Test Rocket after joining

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

The result for the project is aimed for this chapter including the fabrication process,and the problem with the cause of the project. The result will be use to find the ways to solve the problems and make some improvements to the product In this project also,will discuss mainly about the result of the project and all problem encountered during the whole project was been carried out.

4.2 DESIGN IN SOLIDWORKS.

After have the design for the project, the early sketch is transfer to the engineering drawing and also for the solid modeling by using the SolidWorks software to show the actual design for the rocket engine.

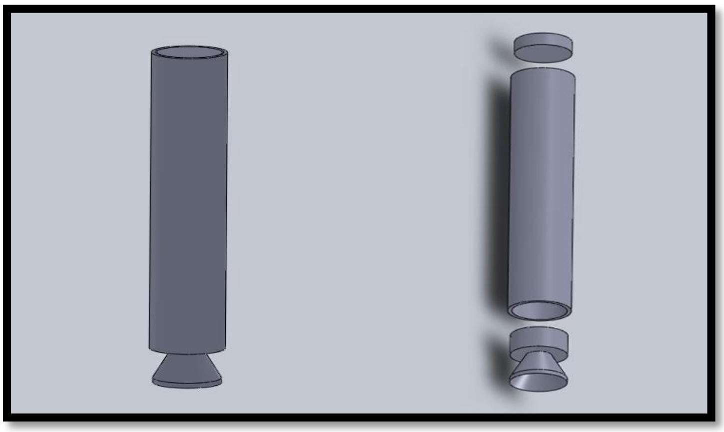

Figure 4.1: Launch Rocket

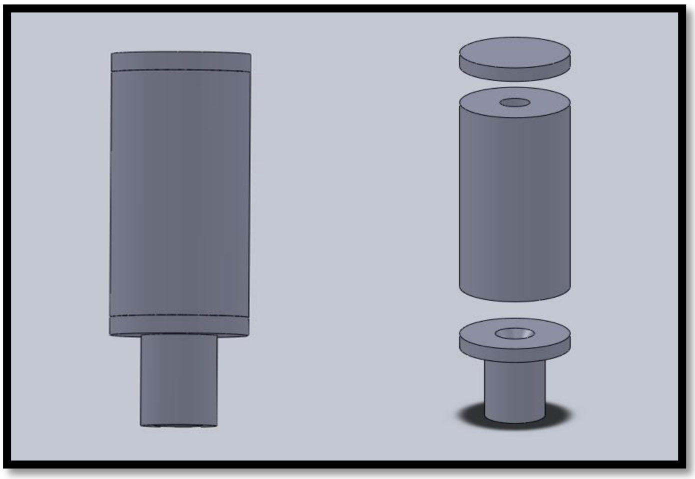

Figure 4.2: Test Rocket

After made an analysis, the body of the rocket engine need the strong material to handle and prevent rocket from burst.

After select the design and the early sketch, the next step are set the dimension and run the dimensioning process. The dimensions were set before run the project drawing in the SolidWorks software according to the relevant dimensions by refer to the currents mini digester and the other parts to make sure all of them were fit.

After the dimensioning process, the solid modeling and the engineering drawing for all the digester parts are run by using the SolidWorks software. Part by part are been draw according to the dimensions that have been set, and after finish the drawing, all the parts were assembled to give and show the actual design for the project.

4 .3 Dimension Drawing

This is the detail of both rocket part by part start from the cap body and nozzle.The dimension is in unit of milimiter(mm).

4.3.1 Test Rocket

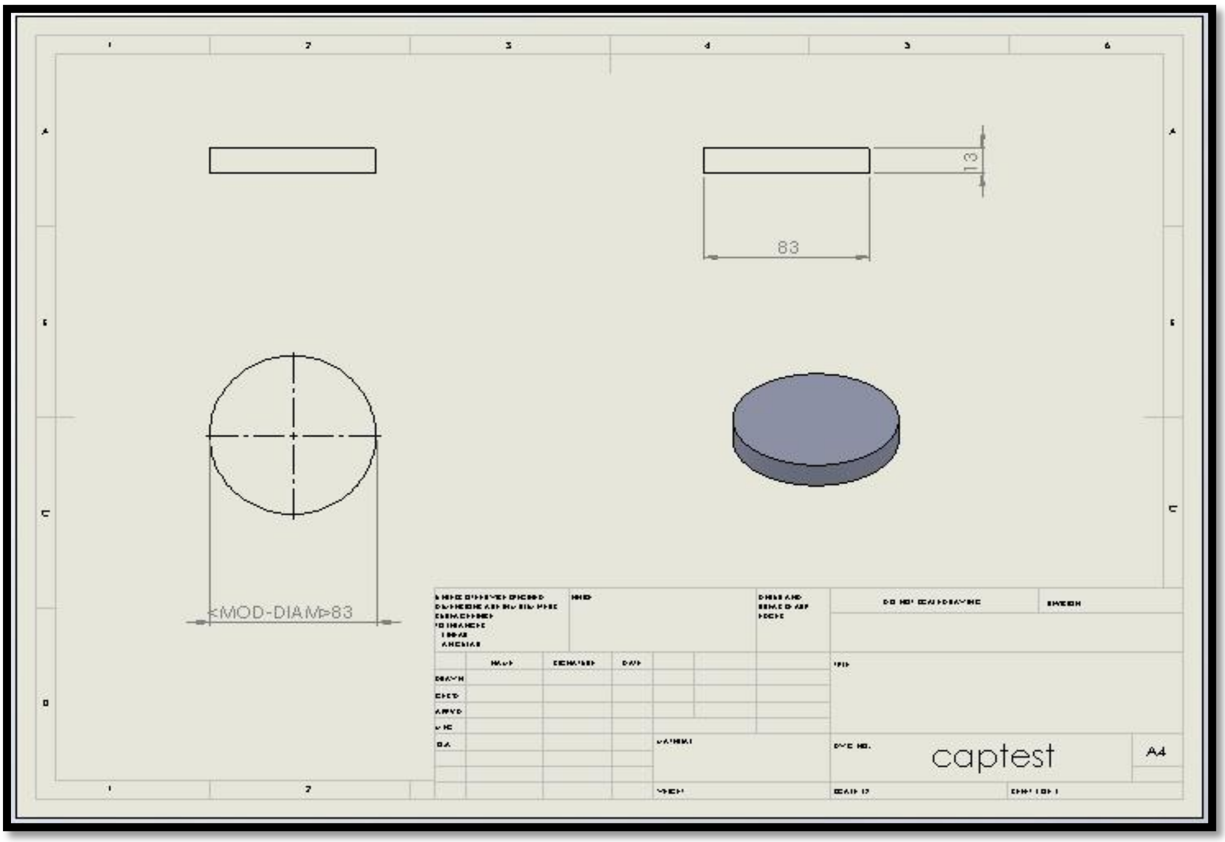

Figure 4.3: Cap Dimension for Test Rocket

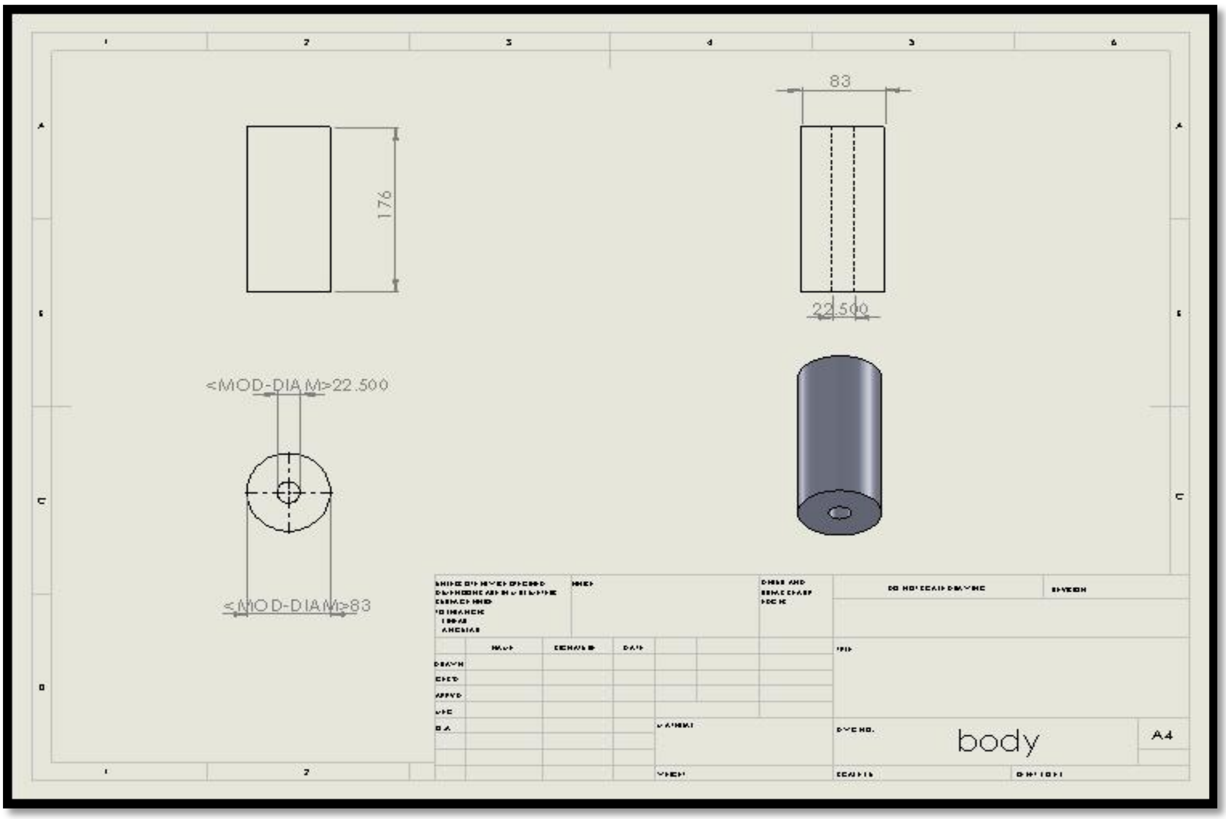

Figure 4.4: Body dimension for Test Rocket

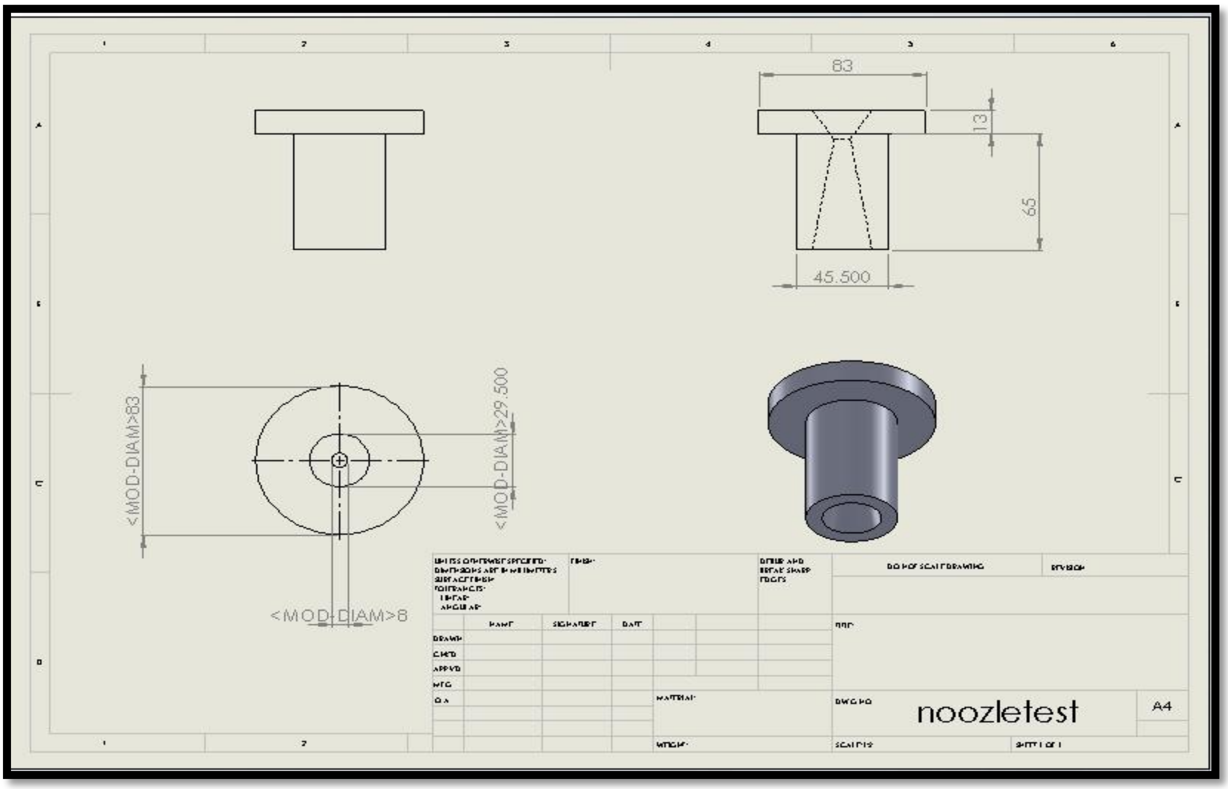

Figure 4.5: Noozle dimension for the Test Rocket

4.3.2 Launch Rocket

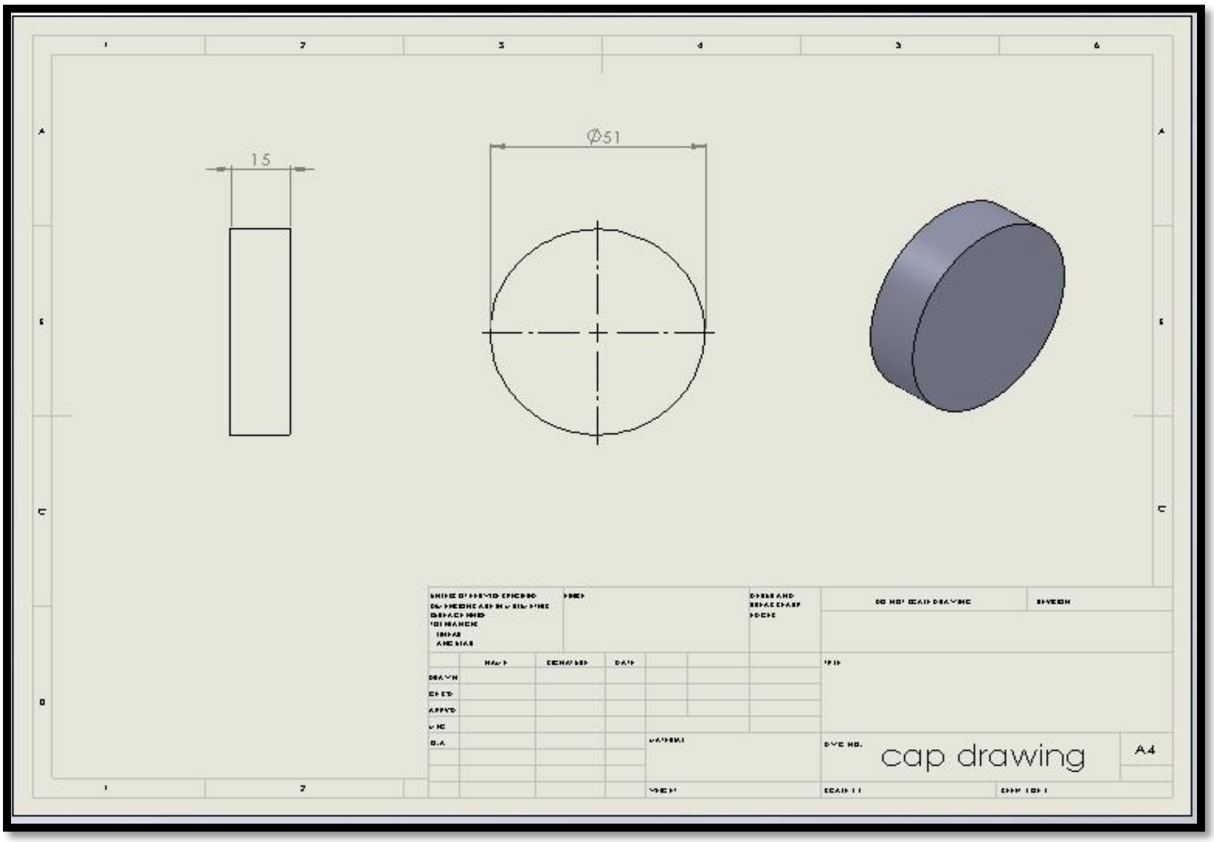

Figure 4.6: Cap dimension for the Launch Rocket

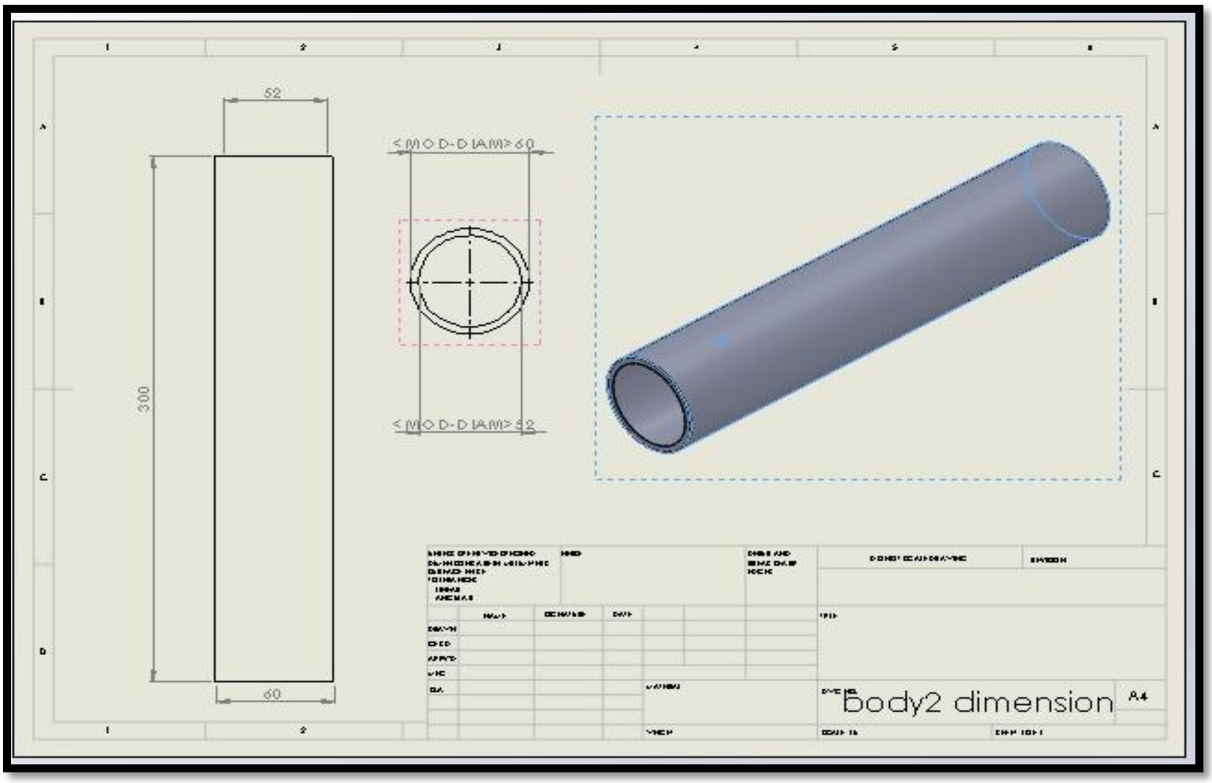

Figure 4.7: Body dimension for the Launch Rocket

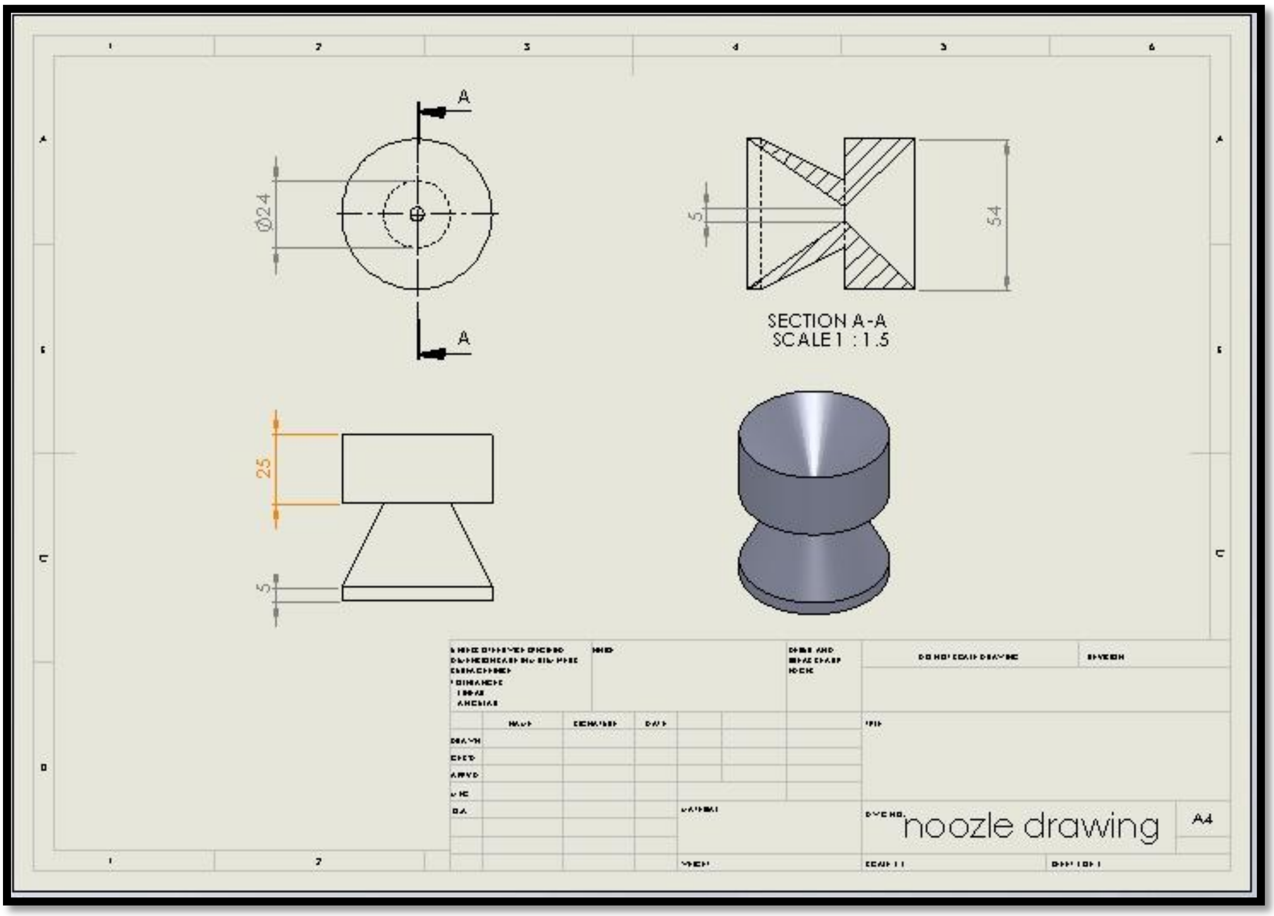

Figure 4.8: Nozzle dimension for the Launch Rocket

4.4 DESIGN DESCRIPTIONS

The design shows the final drawing for the Test rocket engine and Launch rocket engine. Most of the parts are made by solid mild steel, and then follow by hollow pipe mild steel to make launch rocket body. The reason why the steel is mostly use is because of it better properties which are fair corrosion resistance, high technical stability, high temperature resistance and strong.

4.5 MATERIAL

All rocket engine parts just use round hollow steel and round solid steel.But for the joining the allen head bolt were use.Then for the trolley material like aluminimum sheet and iron plate were use.

NO	PART	Material	DIMENSION	QUANTITY
1	**Launch Rocket**	**Hollow rod mild steel**	**0.75cm x 35cm**	**1**
		Solid rod mild steel	**0.8cm x 5.0cm**	**1**
2	**Test Rocket**	**Solid rod mild steel**	**0.8cm x 30cm**	**1**
3	**Trolley**	**Metal sheet**	**37cm x 17cm**	**1**
		Aluminum sheet	**1.5cm x 15cm**	**2**

Table 4.1: Material Selection

4.6 FINAL RESULT

After finish the fabrication the result shown as the figure below:

4.6.1 Launch Rocket

Figure 4.9: Side View of launch rocket

Figure 4.10: Upper View launch rocket

Figure 4.11:Bottom View launch rocket

4.6.2 Test Rocket

Figure 4.12: Side view of test rocket

Figure 4.13 : Upper view test rocket

Figure 4.14: Bottom view test rocket

4.6.3 Trolley

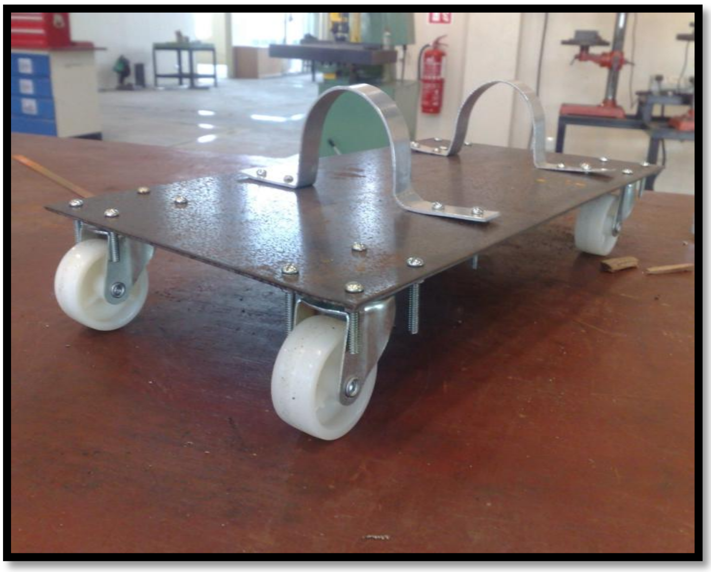

Figure 4.15:3D view of trolley

Figure 4.16: Side view of trolley

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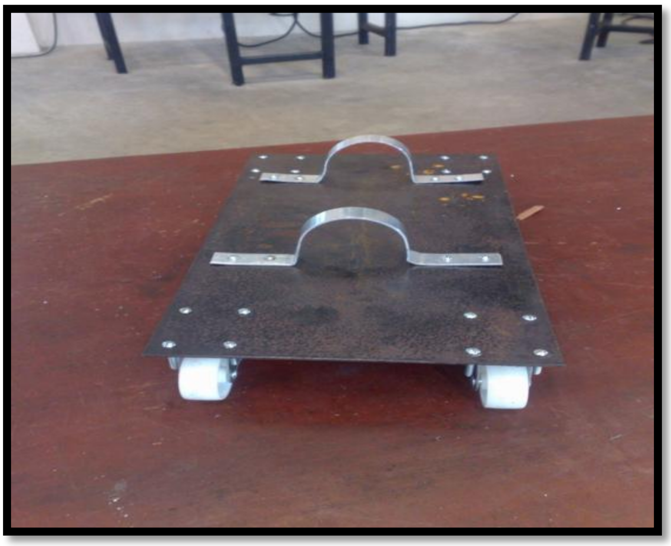

Figure 4.16: Upper view of trolley

4.7 DISCUSSION

In this project,several observation have be done with respect to the fabrication of the rocket engine.The outcome rocket engine was achieve the objective of this project.All the component or part that fabricate can be assemble successfully.

However, both rocket too heavy according to unsuitable material used in the fabrication process.Solid rod and hollow rod mild steel was perfect in strenghtness,but the weight of this material makes this metal not suitable with the rocket engine.Besides that,this material can be corrosion if it surface exposed with oxygen and water.The painting method can be used to prevent this problem.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter is mainly described about all the problems that have been faced during running the project from start until finish. Besides that I n this chapter it will discuss about the project conclusion for the whole of this project too.

5.2 PROJECT PROBLEMS

Literature Review: The ideas and the concepts that review for this project are not very wide because all the information mostly just tells about one type of rocket engine only.It is from common rocket type call solid rocket, and the processes that occur in the making or fabricate is just a prototype of rocket, not more specific to the actually rocket.

Designing The Concept: Actually it is easy for the choosen of design because it have be prepared by my supervisor.All the dimension have be given to me.So it just need to transfer it into the drawing software.But because of the change of material and the limited tool, the design and the dimension also need to change.So the design and dimension need to think and draw back suitable with the material and tool that have.

Materials preparation: Some of the materials were not supplied by the university and the students needed to buy the materials at the city and get the materials from the supplier there.

Fabrication Process: The time needed by the students should be more to finish the project and order the material that not have in the university store because of the slackness of training, so the finishing of the project was not so good but yet still can be reliable.

5. 3 CONCLUSION

The project managed to be completed in the time given and also successfully reaches the objective and the target of the project, and they are achieved. The objectives of this project which is to design and fabricate an rocket engine is be done. The project overall progress was be satisfied after observe by supervisorEven have several problem like have some confusion by time had to start project behind schedule yet this prject still manage to finish it on time.The important things before i graduate many useful skills that were gain from this project although use a major material is steel and usea lathe machine.All the skills are very useful and hope it can be used in my work field after this.This project overall give me alot of experience and really appreciate this knowledge

5. 4 RECOMMENDATIONS

The project planning should be start and done before the project start, do all the process on time according to the Gantt chart, so that all the process can be completed. The skills in fabrication process such using the lathe machine must be improved and well train before running the project. For addition, the project should be improve by using the materials that more light and have better properties, so they can give the best performance, the great features and more ergonomic value to the project.

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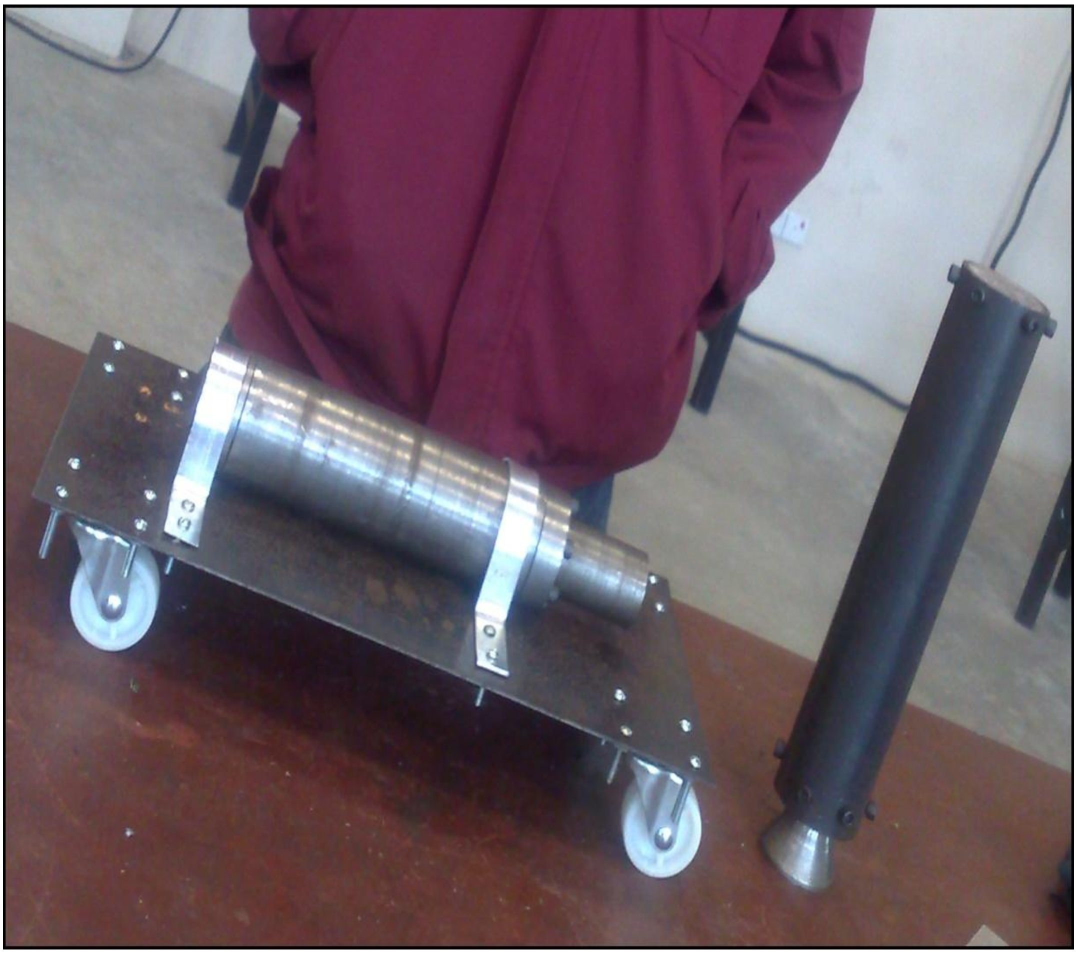
APPENDIX A

RESULT



APPENDIX A2

GANT CHART